

Earth's Hydrosphere

ES-5 The student will demonstrate an understanding of Earth's freshwater and ocean systems.

ES-5.4 Compare the physical and chemical properties of seawater and freshwater.

Taxonomy level: 2.6-B Understand Conceptual Knowledge

Previous/future knowledge: Students in 3rd grade located saltwater and freshwater features on Earth. In 5th grade they studied mixtures and solutions, properties of water as a solvent. In Earth Science the study deepens as students have the basic chemistry background to understand in greater detail the properties of these two types of water found on Earth.

It is essential for students to know that freshwater and seawater have unique properties that are important to processes on Earth. Pure water is a chemical compound whose molecule consists of hydrogen and oxygen (formula = H₂O). Water is not chemically reactive. As the universal solvent, water can dissolve many materials into solution.

Freshwater

Freshwater is one of Earth's more abundant and important renewable resources. It can be found within the temperature conditions on Earth in all three states of matter.

- As a liquid, it flows over Earth's surface and into the ground. It takes the shape of various containers on Earth – lakes, ponds, aquifers, and rivers.
- As a solid freshwater is found in glaciers, snowfields, and the ice caps of Earth.
- Water vapor in the atmosphere is the great mover of water from one location to another on Earth.

Freshwater is a mixture that contains more substances than just pure water.

- As water dissolves materials in rock and soil or pollutants in the air, it can form acid solutions that change the atmosphere, precipitation, and land formations of Earth.
- Freshwater has a density of about 1.0 g/cm³ and freezes at 0°C.

Seawater

Seawater is also a mixture, but it contains more dissolved substances than freshwater.

- It is a solution of about 96.5% water and 3.5% dissolved salts.
- The most abundant salt in seawater is sodium chloride (NaCl).
- Other chloride and sulfate salt compounds are also present.
- Dissolved gases, such as oxygen, nitrogen, and carbon dioxide, are also present along with dissolved nutrients.
- The salinity of ocean water varies from place to place. High salinities are found in areas where evaporation is high or seawater is freezing; low salinities occur where freshwater empties into oceans.
- Other physical properties of seawater include a density of about 1.02 – 1.03 g/cm³. The freezing point of seawater is lower than freshwater at -2°C.

Both freshwater and seawater respond to solar radiation that strikes the Earth's water surfaces.

- *Visible Light:* Water both absorbs and reflects visible light.
 - Most sunlight that reaches Earth falls on the oceans; this sunlight penetrates the surface and is absorbed by water.
 - Most wavelengths of *visible light* are absorbed, but blue light tends to be reflected.
 - All wavelengths of light are absorbed by about 100m depth, so deep lakes and the oceans are dark except for surface region.

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- *Infrared Rays*: Water also has the ability to absorb infrared wavelengths of sunlight.
 - Infrared rays play an important role in determining the temperature of water.
 - Rapidly moving water in fast-moving streams and rivers does not have time to absorb infrared waves.
 - Lakes and ponds, especially shallow ones, become warm as the infrared rays are absorbed.
 - Infrared rays are completely absorbed within the upper zone of ocean water; thus it heats the water only near the surface of the ocean.
 - Surface temperature does vary with latitude – polar seawater is cold or even frozen depending upon the season. Tropical seawater is generally warm all year.
 - Seawater deep in the ocean is very cold.

It is not essential for students to know the atomic structure of a water molecule or how its chemical shape makes it a polar molecule.

Assessment Guidelines:

The objective of this indicator is to *compare* properties of freshwater and seawater, therefore, the primary focus of assessment should be to detect ways that freshwater and seawater are alike or different in regards to their properties.

In addition to *compare* appropriate assessments may require students to:

- *summarize* major points about the properties of freshwater or seawater;
- *interpret* charts or graphs of light or temperature differences with water depth; or
- *recall* the reason water in lakes or the ocean appears blue in color rather than clear.